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USSR Report

ENERGY

(FOUO 12/82)

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ELECTRIC POWER

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INTRODUCTION OF POWER-PRODUCTION CAPACITIES IN INTEGRATED POWER SYSTEMS

Moscow ENERGETICHESKOYE STROITEL'STVO in Russian No 4, Apr 82 pp 46-49

[Article by G. A. Illarionov and Sh. I. Kaliman, candidates of technical sciences, and A. I. Kuzovkin, candidate of physicomathematical sciences: "Optimizing the Introduction of Power-Production Capacities in Integrated Power Systems"]

[Text] When optimization methods and models for planning the development of power systems are utilized, the selection of optimization criteria is particularly important, since the application of the wrong criteria can lead to totally unacceptable solutions. At present we have yet to find a clear answer to the question of which criteria should be applied in problems regarding the optimization of power systems. Even if a criteria is selected, all of its parameters cannot always be determined exactly, especially those which depend upon the economic situation. As an example, let us examine the criterion for minimizing the calculated expenditures $F_z = EK + C$ (where E is the normative coefficient of capital-investment efficiency; K is the capital investment; and C is the operating expenses). This is one of the most economically sound criteria. The decision to apply it in the power industry was approved by the State Committee on Science and Technology. There is not sufficient basis, however, to use the commonly applied figure of 0.12 for E. Moreover, the results of calculations for this criteria can be distorted due to fluctuations in the prices for resources.

Therefore, in the opinion of the authors of this article, when solving problems regarding optimizing the development of power systems, it is necessary to carry out calculations according to various criteria and adopt a final, heuristic solution based upon the results of these calculations. Below are presented the results of short-term calculations of an optimal plan for introducing power-production capacities at thermal electric-power stations of a conventional power system. The calculations were carried out using the criteria for minimizing calculated expenditures F_z, capital investments F_k, the volume of construction and installation work F_s and the maximization of the introduction of power-production capacities N. The latter three criteria reflect only that portion of the production process associated with the construction of thermal electric-power stations. The other part--the operation of electric-power stations and electric-power transmission lines--is not touched upon. The application of these criteria, however, makes it possible to make allowances for a shortage of capital investments and other resources and to increase the concentration of resources at these complexes which will begin operating first.

Table 1

GRES No.	Cost per kWh, kopecks	Variant I			Variant II		
		Output, MW	Capital investment, millions of rubles	Construction and installation work, millions of rubles	Output, MW	Capital investment, millions of rubles	Construction and installation work, millions of rubles
1	0.39	500	187	128	1000	228	142
2	0.72	300	60	40	600	89	60
3	0.55	210	22	15	420	43	30
4	0.56	500	45	33	1000	112	56
5	0.58	300	19	8	600	50	32
6	0.56	300	12	8	600	38	28
7	0.74	0	40	16	800	156	74
8	1.35	100	5	2	200	35	25
9	0.86	800	74	30	1600	141	58
10	0.8	0	76	41	210	96	51

Note: For GRES No. 1, provisions have been made for an additional (third) variant of the plan for the introduction of capacities using the following indicators: output of 1500 MW, capital investment of 271 million rubles, construction and installation work in the amount of 157 million rubles.

Table 2

GRES No.	Calculation variant for planned introduction of capacities, MW															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1000	500	500	1000	500	500	1000	1500	500	500	1500	1000	500	500	1500	1000
2	300	300	600	300	300	600	300	300	300	300	300	300	300	600	300	300
3	210	210	210	210	210	210	420	210	210	210	210	210	210	210	420	210
4	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
5	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300
6	300	600	600	300	300	600	300	300	300	600	300	300	600	600	300	300
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
9	800	800	800	800	1600	800	800	800	1600	1600	800	1600	1600	1600	800	1600
10	0	210	0	210	0	210	210	0	210	0	210	0	210	0	210	210

An analysis of results from calculations carried out according to the entire set of criteria listed makes it possible to draw up a better-substantiated plan of construction for installations which are to come on-line first and those already being built and increases the efficiency of capital investment. Calculations were carried out according to the models presented in [1,2]. The functional extremum in these models is determined with limits imposed on the sum total of introduced capacity, the delivery of power units and the possible ranges of fluctuation in capital investment and the volume of construction and installation work at individual sites and throughout the power industry as a whole. In this case, electric-power overcurrents along high-voltage lines were taken into consideration. The programs being utilized to search for an optimum solution make it possible to determine a multivariant solution that depends upon such indicators as the total volume of capital investment K, construction and installation operations S and the overall introduction of power-production capacities N. The feasibility of carrying out multivariant calculations is of considerable importance for the further analysis of the results obtained.

The authors of this article have calculated optimal variants of a plan for the introduction of capacities in integrated power systems at dozens of conventional GRES's. The acceptable variants of a plan for introducing capacities at GRES's are presented in table 1.

It should be noted that the acceptable variants of the plan for introducing capacities at individual installations are not dependent on one another; that is, the plan for the power system as a whole can include, for example, the first variant of the plan for GRES No 1 and the second variant for GRES No 2. If provisions have not been made for the introduction of new capacities at a particular installation over its planned service period, then it will be necessary to apportion a certain minimum volume of capital investment $K^1{}_i$ and plan the corresponding volume of construction and installation work $S^1{}_i$ (here i is the number of the installation). Thus, only the distribution of the remaining resources is optimized:

$$\left(K-\sum_{i=1}^{10} K^1{}_i\right).$$

In the example being considered, it was assumed that equipment for no more than four 500-MW power units or two 800-MW power units be delivered to a power-production installation during its planned service period. A figure in the range of 3,500 to 4,520 MW was selected for the total power-system demand.

Table 2 presents 16 variants of optimized calculations for the introduction of new capacities at each electric-power station. These calculations were obtained using the criterion of minimization of capital investment F_k for various values of demand in the power system N. Final results of calculations for these variants of the plan are presented in table 3.

The optimized function is a piecewise-constant function of N. Tables 2 and 3 present only those variants of the calculations for which the value of the demand for power N^l (l is the number of the variant) corresponds to the discontinuities of this function; that is, using the data in table 3 one can make a determination about the dependence of the Belman function [3] upon the values of the parameter N.

Table 3

Calculation Variant	Output, MW	Capital investment, millions of rubles	Construction and installation work, millions of rubles	Calculated expenses, millions of rubles
1	3510	582.3	335	178
2	3520	587.4	351.7	185.2
3	3610	596.5	361.3	186.9
4	3720	602.3	345.5	189.1
5	3810	608.3	349.3	206
6	3820	616.5	372.1	197.7
7	3930	624	360.8	197.2
8	4010	625.5	350.1	193.1
9	4020	628.3	359.8	217
10	4110	634.6	369.7	217.6
11	4220	645.5	360.6	203.8
12	4310	649.5	363.3	220.6
13	4320	654.6	380.2	228.5
14	4410	663.7	389.9	229.6
15	4430	667.2	375.9	212.2
16	4520	669.2	373.8	231.6

An analysis of the results of calculations shows that the structure of the optimal plan for the introduction of capacities changes with an increase in the system's demand for power: a number of power units are excluded from the plan and others are inserted into their places. This is associated with the discreteness of the model. The most apparent change in the plan's structure is manifested with a increase in the power demand from 4,410 to 4,430 MW (variants 14 and 15 in table 3).

The reason for the change in the structure of the optimal plan is the fact that there may not be sufficient capital investment for introducing capacities at an electric-power station with a low actual cost per kilowatt of introduced capacity (considering the reserves). As a result, the system's demand for power is covered by introducing power units with a higher cost per kilowatt of installed capacity. With a growth in the overall volume of capital investment, capacities can be introduced in the future at electric-power stations with lower values for this indicator. This process occurs with a transition from one calculation variant to another and can be followed most clearly in the example of GRES No 6. Two 300-MW power units are introduced in variants 2, 3, 6, 10, 13 and 14, while one unit is introduced in the remaining 10 variants. Thus, with a change in the parameter N^l over a broad range the nonlinearity of the problem leads to the absence of a monotonic dependence of the value of the introduced capacity at individual electric-power stations upon the total power demand N^l.

In order to determine all discontinuities of the Belman function, it is necessary to carry out optimization calculations for all values of power demand N^l (with an incremental change $\Delta N^l = N^{l+1} - N^l$) or the entire volume of capital investment K^l (with an incremental change $\Delta K^l = K^{l+1} + K^l$).*

In order to determine the entire set of optimal solutions, the increment ΔN^l or ΔK^l must have a sufficiently small value. For example, in calculations using the criterion F_k (table 3), ΔN^l should amount to 10 MW, while ΔK^l should be 1 million rubles. An increase in the values of ΔN^l and ΔK^l can lead to certain discontinuity points in the Belman function not being found. If, for example, $\Delta K^l = 5$ million rubles and the initial volume of capital investment $K^1 = 581$ million rubles, the 7th and 15th variants of the calculation are not determined. In these cases, however, one can frequently find solutions for the intermediate values of N^l (or K^l). For example, when $N = 3,730$ MW, the optimal solution is given by the fifth variant (table 3), in which the total introduced capacity is equal to 3,810 MW. In this case, it is no longer necessary to carry out calculations for $N^l = 3,740$-3800 MW.

The value of the Belman function and the corresponding optimal solutions make it possible to avoid the undesirable effects inherent in the majority of linear and estimating models. In order to cover a minor shortage of power, for example, the introduction of an additional large power unit is not required.

The dependence of the increase in the volume of capital investment ΔK^l upon the increase in capacity ΔN^l is not a monotonic function. From table 3 it follows that

* Calculations of the volume of construction and installation work are carried out in a similar manner.

Table 4

GRES No.	Optimal variants for calculating planned introduction of capacities, MW							
	1	2	3	4	5	6	7	8
1	1000	1000	500	1500	500	1500	1000	1000
2	210	210	210	210	210	210	210	210
3	300	300	300	300	300	300	300	300
4	500	500	500	500	500	500	500	500
5	300	300	300	300	300	300	300	300
6	300	300	300	300	300	300	300	300
7	0	0	0	0	0	0	0	0
8	100	100	100	100	100	100	100	100
9	800	800	1600	800	1600	800	1600	1600
10	0	210	0	0	210	210	0	210

Table 5

GRES No.	Optimal variants for calculating planned introduction of capacities, MW									
	1	2	3	4	5	6	7	8	9	10
1	1000	500	1000	1000	1500	1000	1500	1500	1500	1500
2	300	300	300	300	300	300	300	300	300	300
3	210	420	420	210	210	420	420	210	420	420
4	500	500	500	500	500	500	500	500	500	500
5	300	300	300	300	300	300	300	300	300	300
6	600	600	300	600	300	600	300	600	300	600
7	0	0	0	0	0	0	0	0	0	0
8	100	100	100	100	100	100	100	100	100	100
9	800	800	800	800	800	800	800	800	800	800
10	0	0	0	0	0	0	0	0	210	0

for the same values of ΔN^l, the values of ΔK^l vary over such a broad range, whereupon the relationship $\Delta K^l/\Delta N^l$ can decrease with the growth of N^l, that is, with the growth of l. In this case, with the increase in N^l, the cost of 1 kW of introduced capacity in the power system decreases; that is, the dependence of the per-unit capital investment upon the amount of output required is not monotonic. The same can be proven for the other indicators. In the 11th variant (see table 3), for example, the expenditures cited for the introduction of 4,220 MW of capacity are less than for the introduction of 3,810 MW (variant 5), while the volume of construction and installation work is less than with the introduction of 3,610 MW (variant 3). The maximum expenditures cited (231.6 million rubles) correspond to calculation variant 16 using the criterion F_k, while the maximum volume of construction and installation work (389.9 million rubles) corresponds to variant 14. The minimum expenditures cited and the minimum value for the volume of construction and installation work (178 and 335 million rubles, respectively) are reached in the first variant. With the introduction of 4,430 or 4,520 MW, the volume of construction and installation work decreases.

In the calculations cited, the minimum volume of capital investment necessary

$$\sum_{i=1}^{10} K'_i$$

amounts to 451.1 million rubles, which corresponds to an introduced capacity of 3,010 MW. The remaining portion of the system's power demand is covered through the introduction of additional power units at 6 of the 10 electric-power stations. The number of power units whose introduction is possible during the planned service period varies from one to three at individual power stations.

Table 4 presents optimal plan variants for introducing capacities at individual power stations. These variants are calculated using the criterion for minimizing the volume of construction and installation work F_s. Table 5 presents variants computed according to the criterion for minimizing calculated expenditures F_z. Final results from calculations of the planned introduction of capacities according to these minimization criteria are shown in table 6.

It can be seen from tables 4 and 5 that a variation in the solutions according to criteria F_s and F_z is possible at the same six electric-power stations as in the case of calculations using criterion F_k. Naturally, this fact is associated with the selection of a number of acceptable plan variants and with the system of limitations. If, for example, we relax the limitations on the volume of equipment deliveries, assuming that equipment for more than four 500-MW power units can be delivered in the planned period, then additional capacities can be introduced at GRES No 4. In this case, for N^l= 4,510 MW there exists an optimal solution according to F_s, differing from the solution for variant 8 (see table 4) which provides for the introduction of a second power unit at GRES No 4.

The priority of various power stations varies. For example, the results of calculations according to criterion F_k show that with a power system demand of 4,520 MW, the introduction of a power unit at GRES No 10 is more preferable to the introduction of a second unit at GRES No 3 (see table 2). Using criterion F_z, the opposite case is true (see table 5).

Table 6

Calculation variant	Output, MW	Capital investment, millions of rubles	Construction and installation work, millions of rubles	Calculated expenses, millions of rubles
1	3510/3510	582.3/582.3	335/335	178/178
2	3720/3520	602.3/589.1	345.5/356.6	189.1/183.7
3	3810/3720	608.3/604	349.3/350.2	206/186.6
4	4010/3810	625.5/608.6	350.1/355.4	192.1/189.8
5	4020/4010	628.3/625.5	359.8/350.1	217/193.1
6	4220/4020	645.5/630.3	360.6/370.6	203.8/198.2
7	4310/4220	649.5/647.2	363.3/365.4	220.6/201.4
8	4520/4310	669.5/650.8	373.8/370.5	231.6/204.6
9	4430	667.2	375.9	212.2
10	4520	673.5	385.8	212.7

Notes: 1. The numerators show the results of calculations according to criterion F_s, the denominators according to criterion F_z.

2. Variants 9 and 10 are carried out according to criterion F_z.

Table 7

N^l, MW	ΔK, millions of rubles	ΔC, millions of rubles
3150	-20	15
3300	-14	14.5
3400	-12	15.5
3500	-11	16
3600	-4/-13*	+11/+12*

* The numerator shows the values of ΔK and ΔC when $E = 0.15$ or 0.12; the denominator when $E = 0.1$ or 0.08.

It should be noted that optimization according to one of the functionals does not always lead to an optimal solution with respect to the other two. For certain values of N^l, however, the extremum of the various functionals can be achieved on one and the same plan. For example, when N^l = 3,510 and 4,010 MW, the optimal plans for the introduction of capacities coincide for F_k, F_s and F_z; when N^l = 3,720, 3,810, 4,020, 4,220, 4,310 and 4,520 MW, plans coincide for F_k and F_s; and when N^l = 4,430 MW, plans coincide for F_k and F_z.

Thus, the optimal solution also minimizes F_k for all eight calculation variants according to F_s. This occurs because of the natural relationship between the volumes of construction and installation work and capital investment. The noncoincidence of the solutions according to criteria F_k and F_z is associated with the fact that operational expenditures at capital-intensive power stations can be lower than at those that are less capital-intensive.

In order to delect a final solution, it is necessary to conduct an additional analysis of the calculation variants under examination. The data cited in tables 3 and 6 show that the gain in calculated expenditures leads to an increase in capital investment (usually small) and to a considerable increase in the overall volume of construction and installation work. For a power-system demand of 4,520 MW, for example, the realization of an optimal solution according to F_z insures a reduction in calculated expenditures of 18.9 million rubles. For N^l = 4,310 MW, these indicators are 16 and 17.2 million rubles, respectively. For N^l = 4,220 MW, they are 3.4 and 4.8 million rubles, and so forth.

Therefore, it is important that the optimal plan for the introduction of capacities calculated according to the minimization criterion F_z does not exceed the limitations on the total volume of construction and installation work. If the total volume of work does not exceed 361 million rubles, the optimal solution according to criterion F_z with a power demand of 4,220 MW coincides with calculation variant 11 (see table 2), in which a power unit is installed at GRES No 10 instead of the second power unit at GRES No 3. This plan will be an equilibrium point (optimum according to Pareto) for F_s and F_z. Since, as we have noted, the value of the normative coefficient of capital-investment efficiency E (0.12) is not sufficiently substantiated, it is necessary to check the stability of the optimal plan when this factor varies. Therefore, calculations were carried out for the optimum introduction of capacities for 10 electric-power stations using the criterion F_z with E = 0.06; 0.08; 0.10; 0.12; and 0.15. Power-system demand N^l was taken to be equal to 3,150, 3,300, 3,400, 3,500 and 3,600 MW.

The results of the calculations showed that the optimum solution was stable with fluctuations in E over the indicated range of values for all values of N^l except N^l = 3,600 MW. The difference between the solutions derived and the optimal plan calculated according to F_k is characterized by the values presented in table 7.

Instability of the solution with a minimization of the calculated expenditures was also observed in other practical calculations. Thus, the optimum solution according to this criteria should be confirmed by calculations using other criteria, stability studies and additional analyses.

The final selection of a plan for the introduction of power-production capacities should be carried out on a heuristic basis, with consideration given to the results of multivariant optimization calculations which characterize the behavior of basic plan indicators with variations in the most important plan limitations.

BIBLIOGRAPHY

1. Kaliman, Sh. I., Kuzovkin, A. I., and Panfilov, V. N., "A Model of the Annual Distribution of Capital Investment in the Construction of Initial Electric Power Stations and of Stations Already Being Built," ENERGETICHESKOYE STROITEL'STVO No 3, 1977, pp 73-78.

2. Kaliman, Sh. I., Kuzovkin, A. I., and Panfilov, V. N., "Models for the Optimal Distribution of Capital Investment in the Power Industry," ENERGETICHESKOYE STROITEL'STVO No 4, 1978, pp 72-77.

3. Belman, R., "Dinamicheskoye programirovaniye" [Dynamic Programming], Moscow, Izdatel'stvo inostrannoy literatury, 1960.

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PIPELINES

GOSPLAN SHOULD RATIONALIZE OUTPUT, USE OF ALL TYPES OF PIPE

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 4, Apr 82 pp 67-72

[Article by N. Bogatov, deputy chief of a USSR Gosplan section: "Ways to Save Metal During Pipe Manufacture"]

[Text] The circumstances of social production have experienced considerable changes in recent years. The regions where raw materials and mineral fuels are obtained are consistently more distant from the traditional places of consumption, and, accordingly, the freight turnover for all types of transport is increasing. Expenditures for protecting the environment are rising substantially. And other factors are complicating economic development.

Under the prevailing situation, improvement in management of the economy and in the planned guidance of economic affairs, and, particularly, the development and execution of specific-purpose integrated scientific, technical, economic and social programs within the state plan for the USSR's economic and social development are becoming urgent tasks. Among the programs that are paramount in the immediate future is that of saving metal.

Experience indicates that it is practically impossible to make up a unified, integrated program for saving all types of metal.

It is desirable to discuss the use of metal products of the same kind, for example, steel, cast-iron and nonmetallic pipe. By doing this, the time consumed in preparing and realizing the programs is reduced and production effectiveness is increased, since the problem of savings can be examined more broadly and comprehensively. This approach distinguishes the specific-purpose integrated scientific and technical programs for improving the pipe-consumption structure in the national economy, including capital construction, that USSR Gosplan has developed jointly with GKNT [State Committee for Science and Technology], USSR Gosstroy, USSR Minchermet [Ministry of Ferrous Metallurgy] and other interested USSR ministries and agencies.

The intensive development of pipeline transport for moving crude oil and natural gas over great distances, the creation of new irrigation systems in areas with an arid or unstable climate, the great scope of housing and municipal-services construction, and the rising output of machinebuilding products are necessitating an increase in steel-pipe production. In the last 5 years it has grown by 3-3.5 million tons.

Consumption norms govern the distribution and consumption of pipe in the national economy. The role of scientific justification of consumption is exclusive here. A study of the methods for pipeline analysis and engineering solutions and of the construction norms and regulations for the design of pipeline systems shows that they are not identical. Some computational methods yield overstated thicknesses of the pipe walls. This is explained by the fact that the computed resistance of the pipe material intended for trunk gas and oil pipelines that operate at pressures up to 7.5 MPa is assumed to be 30-50 percent higher than for less heavily loaded (0.6-1.5 MPa) air lines, gas-distribution lines, water mains, land-reclamation and other piping systems. Thus the metal intensiveness of the above-named systems is exaggerated right at the design stage.

Further, various construction norms and regulations restrict the area of use of welded pipe unjustifiably. Preference is given to seamless pipe, which is more expensive than welded pipe and whose manufacture causes great specific technological losses of metal. The use of seamless pipe where operating conditions allow welded pipe to be used raises considerably the cost and metals intensiveness of utilities structures.

The indicated deficiencies testify to the need to review pipeline-analysis methods and the standardizing documents on the basis of scientific and technical achievements.

USSR Gosstroy design institutes (TsNIIproyektstal'konstruktsiya [Central Scientific-Research and Design Institute for Metal Constructional Structure], VNIIvodgeo [All-Union Scientific-Research Institute for Water Supply, Sewerage Systems, Hydraulic-Engineering Structures and Engineering Hydrogeology] and Vodokanalproyekt [Institute for the Design of Water-Supply and Sewerage Systems] and USSR Minchermet [Ministry of Ferrous Metallurgy] scientific-research institutes (VNITI [All-Union Scientific-Research and Technological Development Institute for the Pipe Industry] and UralNITI [Urals Scientific-Research and Design-Development Institute for the Pipe Industry], with the participation of similar USSR organizations of interested ministries and agencies, have analyzed design solutions for the construction of 442 representative facilities of 11 branches of the economy.* Proposals for changing the standardizing documents that govern the use of pipe in capital construction and for establishing a structure for steel-pipe consumption that is less metals-intensive were set forth. The data cited in table 1 show that rationalization of the consumption structure for steel pipe will enable the weight of the pipe to be reduced from 1,399,190 tons to 1.029,370 tons without reducing the length, that is, a reduction of 29.5 percent of the weight.

Based upon a study of engineering solutions for construction of the very same representative facilities, the Plastik NPO [science and production association] worked out proposals to replace steel pipe with plastic pipe. Thus, instead of the 364,000 tons of steel pipe called for by the designs, 105,000 tons of plastic pipe can be used (table 2). Proposals were worked out for replacing steel pipe with pipe manufactured also from other nonmetallic materials: reinforced concrete, glass and so on.

The total reduction in the consumption of steel pipe in capital construction through reduction of the metals intensiveness of the pipe and the replacement

*Automotive plants, oilfields, blast furnaces, pipe-rolling departments and others are included.

Table 1

Reserves for Reducing Metals Intensiveness of Pipeline Systems Based upon Unification of Methods for Analyzing Pipelines

Ministry	Weight of pipe that supports the functioning of representative facilities (thousands of tons)		Reduction in pipe weight	
	Design	Recommended by institutes	1,000 tons	Percent
USSR Ministry of Land Reclamation and Water Resources	584.8	437.1	147.7	25.3
USSR Ministry of Agriculture	235.7	162.5	73.2	31.1
Ministry of Petroleum Industry	121.9	92.1	29.8	24.4
USSR Ministry of Ferrous Metallurgy	119.8	89.5	30.2	25.3
Ministry of Chemical Industry	83.0	61.7	21.2	25.6
Ministry of Gas Industry	75.7	63.0	12.7	16.6
USSR Ministry of Power and Electrification	61.3	43.3	18.0	30.6
USSR Ministry of Nonferrous Metallurgy	55.0	37.9	18.1	32.3
Ministry of Automotive Industry	47.9	32.4	15.5	32.3
Ministry of Tractor and Agricultural Machine Building	11.0	8.4	2.6	23.6
USSR Ministry of Geology	2.1	1.5	0.6	28.4
Total	1,399.2	1,029.4	369.7	29.5

Table 2

Amount of Steel Pipe Replaced by Plastic Pipe for the Construction of Representative Facilities (from Computations by the Plastik Science and Production Association)

Ministry	Pipe weight (thousands of tons)	
	Steel and stainless steel replaced	Plastic to replace the steel
USSR Ministry of Land Reclamation and Water Resources	187.3	55.0
USSR Ministry of Agriculture	91.8	19.7
Ministry of Petroleum Industry	11.7	4.5
USSR Ministry of Ferrous Metallurgy	36.1	6.5
Ministry of Chemical Industry	6.4	1.1
Ministry of Gas Industry	1.8	0.4
USSR Ministry of Power and Electrification	1.6	0.4
USSR Ministry of Nonferrous Metallurgy	11.6	2.25
Ministry of Automotive Industry	8.5	1.8
Ministry of Tractor and Agricultural Machine Building	6.4	1.1
USSR Ministry of Geology	0.6	0.1
Total	363.8	104.85

thereof by plastic, reinforced-concrete and glass pipe can reach 2-2.5 million tons by the end of the 11th Five-Year Plan.

Progress in pipe production is manifested in the more complete and rational use of the engineering potential of existing tube mills and units; expansion in the variety of pipe, especially hot-rolled pipe; and the use of composites that combine the best properties of steel, plastic and other materials and of anticorrosion linings. There is also a great reserve in the increased manufacture of welded pipe with walls thinner than those of the traditional varieties.

Seamless pipe less than 52 mm in diameter is manufactured at present by cold deformation. However, this method is marked by intensiveness in materials, capital, labor, and energy greater than for hot-rolled pipe. An expansion of the mix of the latter with a reduction in the diameter at existing continuous pipe-rolling mills and the creation of new mills with greater capabilities are among the main areas for improving equipment and technology in ferrous metallurgy in the short term.

In the chemical, petrochemical, oil-refining and certain other branches of industry, pipelines are extremely often designed for the transport of aggressive substances. Expensive high-quality pipe made of stainless steel goes into these designs. But in such branches as shipbuilding, the use of lined pipe, which combines the high strength of steel pipe and the chemical resistance of plastic pipe, has proved itself well. Current output of the pipe is about 450,000-500,000 tons per year and does not by far satisfy the national economy's needs. The appearance of new areas for using this pipe instead of stainless steel will increase the reliability and longevity of pipeline systems and reduce considerably expenditures for producing it.

Organization of the large-scale production of enameled pipe should be a promising area.

An analysis of the steel-pipe consumption structure indicates that a substantial portion of industrial pipelines in certain branches of industry is intended for transporting product that is highly abrasive. Product pipelines erected from thin-walled carbon pipe are poorly suitable for such purposes, and they do not last long (1-2 years of service). Thickening the walls of steel pipe does not bring a considerable increase in the length of service of industrial pipelines and does not reduce operating costs. The use of cast-stoneware pipe yields substantial benefit. However, large-scale output of it has not been arranged yet.

Scientific and technical progress in developing the production of pipe made of nonmetallic and of composite materials should be aimed in the next few years at raising its load-carrying capability (strength) and heat and chemical resistance. The investigation of nonthreaded pipe and of joining methods that are reliable but not labor intensive, the development of methods for bending thin-walled pipe without loss of stability of the cross-section, and the organization of production with maximum preparation of the product for assembly are associated with the use of pipe in the consumer sphere.

An acceleration of scientific and technical progress in pipe production can at first lead to an increase in specific and overall expenditures. Therefore, an isolated evaluation of the effectiveness of measures for improving equipment and technology will be unreliable. An evaluation of these measures should take into account the reduction in the use of materials, labor, energy, investment and other expenditures throughout the whole metallurgical cycle--from the mining of the ore to the production of the pipeline systems.

Tons and meters are being used as in-kind indicators for pipe production. Fifteen different types of pipe are planned and distributed in tons and meters. The output thereof in 1979 amounted to 16.6 million tons, or 1,588 million meters. Only 5 types of pipe, whose output that year was 1,028 million meters (which corresponds to 1.1 million tons), are planned and distributed in meters.

In our view, the linear measurement helps to a great extent to raise production effectiveness. Its acceptability for planning, costing and accounting has been proved by the many years of work experience of pipe plants.

Some economists consider it possible to retain the weight measurer for the volume of production output. In order to justify their point of view, they point to the striving of customers whose funds are allocated in tons to order pipe with reduced wall thickness in order to allow a larger amount of product (in linear units of measurement) to be obtained for the very same amount of funds. And, on the contrary, the allocation of funds in meters would seem to persuade customers to order pipe with increased wall thickness, which will enable the longevity and reliability of utilities structures to be raised.

In resolving the question of the priority of indicators for pipe production, the following should be kept in mind.

The productivity of pipe mills is a function of the sizes of the pipe being manufactured. With increase in wall thickness but the same diameter, the hourly production of pipe mills in tons increases proportionally. With decrease in wall thickness, the opposite picture is observed: the productivity of the pipe mills in units of weight is reduced, while in linear units it grows or stays unchanged. If, as a result of improving the consumption structure of pipe, wall thickness must be decreased, the use of the weight indicator causes a reduction in production volume. The result will be a seeming reduction of resources.

Also among the planning, evaluative and fund-forming in-kind indicators is the amount of output of products of the highest quality category, which is measured also by either tons or meters. Accordingly, everything set forth relates also to the planned production of this output. The assertion of the proponents of the weight measurer that the distribution of pipe in tons promotes the ordering of less metals-intensive output is not confirmed in practice.

The interrelationships of the planning organs and pipe producers and consumers take the following form. Development of the annual production plan (in tons) is begun in the first quarter of the preceding year, when the requirement for pipe for the following year by size is still not known, to either the customer or the planning organs. The plan calls for the complete use of high-capacity pipe mills, taking the product mix into account. The desire of the customers at the plan-realization stage to obtain a larger number of meters is practicable, provided there is a reduction in production in tons. But revision of the distribution plan, and then also of the production plan, is not permitted. As a result, the customer is allocated products with increased metals intensiveness under the orders schedule.

Pipe production is planned by realized, commodity, and gross output indicators. The last two are categorized as settlement indicators. However, the gross output indicator is assigned a more significant role than is customarily thought, since labor productivity is computed by means of it. This circumstances requires thorough analysis of the influence of scientific and technical progress on the materials intensiveness of the output and the cost indicators of production.

Gross output can be presented as a result of the production of a volume of output expressed in in-kind measurement units, based upon the price of a unit of output.

The price for pipe for a definite amount of output in linear measurement units with a reduction in metals intensiveness is changed in full correspondence with the change in the socially necessary costs of production. Material expenditures make up about 80 percent of the prime operating cost structure of pipe production. The remaining 20 percent consists of labor, power and other production outlays. The first expenditures--the variables--are a function of the amounts of output produced. The second--the constants--are not functions of it. Specific expenditures can thus be represented as the sum 0.8S + 0.2S (where S is the prime cost of pipe production).

Where there is a reduction in the metals intensiveness of the output, if the amount is measured in linear units, specific materials expenditures are reduced and the constants are retained. If the output is figured in weight measurements, then the material expenditures per ton of output are retained, despite the reduction in metals intensiveness thereof, and the constants per ton increase because of the reduction in the amount of pipe production.

The dependence of the price (Ts) and the expenditures Z on pipe production can be expressed by the equation

$$Ts = ZK,$$

where K is the coefficient that considers the bulk of the profit in the price of the pipe.

If, as a result of taking scientific and technical measures, metals intensiveness of the output has been reduced, by 20 percent for example, then the materials expenditures per 1 meter of pipe also are reduced by 20 percent, and the value of the constant remains as before. Total outlays for producing output of lesser metals intensiveness will be equal to

$$Z = 0.8 \cdot 0.8S + 0.2S = 0.84S.$$

The output volume of pipe of reduced metals intensiveness, in meters, has been kept at the former level, and the amount of gross output (V) is computed in accordance with the formula

$$V = 0.84\ PTs,$$

where P is the amount of output expressed in in-kind terms.

The reduction of metals intensiveness of output by 20 percent will lead to a 16-percent reduction in gross output through a reduction of materials expenditures. The labor productivity indicator, which is computed in accordance with gross output, is reduced by that same amount.

Where the output is measured in weight units, the results of a reduction of its metals intensiveness will not be reflected in the specific material expenditures. They will remain constant. Only the amount of product output is reduced.

Where there is a reduction in the amount of output, specific constants of expenditure will rise by 20 percent, and where there is production of output of lesser metals intensiveness, they will be

$$Z = 0.8S + 1.2 \cdot 0.2S - 1.04S.$$

The amount of gross output when its production is planned in weight measurements will be equal to:

$$V = 0.8P \cdot 1.04Ts = 0.832PTs.$$

The influence of a reduction of the materials intensiveness of output on reduction of cost-of-production indicators is intensified as the materials expenditures for production decrease. This relates to the production not just of pipe but also of any other items in which the material expenditures exceed the other outlays.

Table 3 shows the technical and economic indicators that could characterize the production of electrically welded pipe of just one size at the Volga Pipe Plant. A reduction of the pipe's metal intensiveness during a conversion to walls that are 20 percent thinner would enable its weight to be reduced by 36,400 tons (16.7 percent) and the amount of production to be increased by 222,000 meters (10.6 percent). However, the gross output and labor productivity would be reduced by 13 percent. Because of deficiencies in setting prices, profit from the realization of output at the plant will be reduced by 900,000 rubles, although the expenditures for producing the pipe of reduced metals intensiveness is cut by 4.1 million rubles. The amount of the economic incentive funds will be reduced by 39 percent as a consequence of the change in the fund-forming indicators.

Table 3

Technical and Economic Indictors for the Production of Pipe of Lesser Metals Intensiveness at the Volga Pipe Plant

Indicator	Dimensions of the pipe, in mm		Change of indicators	
	530x8.0	530x6.0	In absolute value	In percent
Pipe production volume:				
Thousands of tons......................	218.2	181.8	-36.4	16.7
Thousands of meters....................	2,088.0	2,310.0	+222.0	10.6
Gross output, millions of rubles' worth...	38.4	33.4	-5.0	13.0
Prime production costs, millions of rubles	33.7	29.6	-4.1	12.2
Profit, millions of rubles................	4.7	3.8	-0.9	19.0
Profitability, percent....................	13.9	12.8	-1.0	7.0
Labor productivity, thousands of rubles per person............................	24.9	21.6	-3.3	13.0
Material-incentives fund, percent..........	100.0	61.0	-	39.0

Change in the technical and economic indicators of the production of pipe of reduced metals intensiveness at the Chelyabinsk Pipe-Rolling Plant, the Leningrad Pipe Plant, the Vyksa Metallurgical Plant and other plants has that same tendency.

A paradox arises: the greater the influence of scientific and technical progress on reduction in the metals intensiveness of output, the less the output of gross product, and the lower the labor productivity. It can be eliminated if the indicator for standard-equivalent net output, which materials intensiveness does not affect, is used as the indicator for planning production and evaluating the collectives' activity.

The objectivity of evaluating scientific and technical progress in pipe production is intensified if the introduction of new equipment and technology, improvement of product quality, and reduction in expenditures for the manufacture of pipe output are reviewed, taking into account the qualitative and quantitative changes that emerge throughout the whole cycle of metallurgical production, beginning with the mining of the iron ore. For example, water-and-gas conduits from 20 to 76 mm in diameter and with a wall thickness of 2.2-4.5 mm are being used widely to protect electrical conductors. At the same time, experience has also indicated the acceptability of thin-walled electrically welded pipe with wall thickness half as great. Each year the amount of use of water-and-gas conduits for the indicated purposes in the national economy totals about 200,000 tons. Replacing them with thin-walled electrically welded pipe, which was occasioned by a number of changes in the technology for manufacturing metal products and with reworking thereof in the consumers' sphere, enables rolled-metal consumption in pipe production to be cut in half for the same number of meters of pipe.

The manufacture of thin-walled electrically welded pipe is possible not from hot-rolled but from cold-rolled strip. Thus, prior to replacing water-and-gas conduits with thin-walled electrically welded pipe, the production of almost 100,000 tons of cold-rolled steel coils per year should be organized, for which about 20 million rubles of capital investment is needed. This path for satisfying the national economy's rising requirement for rolled metal by saving in the traditional areas of its use is preferable to organizing new rolled-metal production throughout the whole metallurgical cycle, when the creation of production capacity for the mining and beneficiation of iron ore, the production of coke, the melting of pig iron and steel, and, finally, the output of rolled metal, is required. Capital expenditures for creating capacity for 100,000 tons of rolled metal throughout the whole metallurgical cycle will exceed several tens of millions of rubles.

A scientifically sound choice of directions for technical progress in the production of pipe (or metals, materials, and other types of output) will enable a reduction in capital investment for the industry's development and the creation of a potential for the selective use of the resources that have been saved for solving social problems: the construction of housing, children's institutions and facilities for public health, culture, education and so on. Moreover, additional possibilities for improving the system of collective material stimuli are opened up.

Part of the metal saved and the additionally manufactured output that is less materials intensive can be partially or completely allocated in a planned procedure to manufacturing enterprises and to consumer organizations for such output, above the established volume. Additional allocation of material resources precisely to those enterprises that have reduced their consumption will enable fixed assets, labor resources, fuel and electricity to be used more completely and the material basis for the development and realization of counterplans to be established.

In 1981 our country manufactured more than 18 million tons of steel pipe, more than the USA, France, the FRG and England put together. However, nonmetallic pipe still is not being used adequately.

Steel pipe made of stainless steel and carbon steel, pipe lined with plastic, enameled pipe, pipe made of low-alloy steels, thick-walled and cast-stoneware pipe, electrically welded large-diameter steel pipe, and reinforced-concrete and plastic pipe possess exceptionally high interchangeability. But the engineering solutions for operating pipe made from different materials are not equivalent from the economic point of view. The intensiveness of capital, energy, materials and labor in the production of each type of pipe has essential differences, indicating the necessity for the integrated, mutually related development of pipe production. Such an approach still has not been realized completely.

Several USSR Gosplan sections are occupied with planning pipe production. Dispersion of the development of current and long-range plans for the production of steel, plastic, reinforced-concrete and other types of pipe is one of the factors in the disproportions of their output. It has an influence on the engineering solutions for design. An analysis of designs for the construction of pipeline transport has confirmed the inadequacy of their effectiveness.

Contractor designs for the erection of ordinary water-supply systems call for electrically welded pipe. The operating pressures in water-supply systems whose designs have been approved by consultant services are 0.3, 0.6 and 1 MPa. When erecting pipelines that are designed on the basis of this pressure, it is desirable to use pipe made of nonmetallic materials, the outlays for production, the installing costs and the operating expenditures for which are considerably lower. The same can also be said about the use of other members of the mix of types of steel pipe: water-and-gas conduits, seamless and electrically welded oil pipeline, rolled pipe, and so on.

In order to optimize plans for developing pipe production, it is desirable to concentrate the formulation of plans for the production and distribution of all types of pipe in one structural USSR Gosplan subunit.

A characteristic and distinctive feature of program control is the interrelated step-by-step examination and solution of all questions. The preparation of designs, the review of standardizing documents and materials-consumption norms, improvement of the equipment for the technology of production, and improvement of product quality and of the system for planning and evaluative indicators of the activity of ministries, production associations and industrial enterprises are organically incorporated into an overall integrated program, despite the diverse nature of the technical and economic methods of control. Within the framework of a specific-purpose integrated program, it is possible to establish tasks for various stages and types of operations, indicating the implementers and the deadlines for implementation.

In generalized form, the methodology for developing integrated programs for saving material resources is:

scientific study of existing material-resources consumption;

improvement of methods for analyses and for standardizing documents that regulate the terms for using material resources;

the development and coordination with customers and manufacturers of a progressive materials-consumption structure;

the execution of measures for improving equipment and technology in the spheres of production and consumption of materials resources;

a review of the system of plan indicators; and

improvement of the system of economic levers and stimuli and of the production control structure.

Any stage (or chapter) of an integrated program is of an interindustry nature and should be reflected in the national economic plan. Specific-purpose integrated programs that call for a basis for a systems, step-by-step approach to the solution of questions of improving design matters, consumption norms, improvement of output quality on the basis of scientific and technical progress, and strengthening of the effect of economic methods of control are reliable means for raising considerably the effectiveness of social production and quality of work.

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GENERAL

TERRITORIAL-PRODUCTION COMPLEXES IN 11TH FIVE-YEAR PLAN

Moscow SHAGI ODINNADTSATOY: TERRITORIAL'NO-PROIZVODSTVENNYYE KOMPLEKSY SSSR in Russian 1982 pp 40-57, 62-72

[Selected chapters from book "Strides of the Eleventh: Territorial-Production Complexes of the USSR", by A. N. Gladyshev and V. P. Mozhin, Politizdat]

[Text] 1. West Siberian Territorial-Production Complex

"Ensure further development of the West Siberian territorial-production complex."

From the "Basic Directions...."

The economic growth of the West Siberian complex is based on the diversity of natural resources concentrated on its territory. The fuel resources, in relation to the total reserves of which the complex occupies a leading place in the country, and its timber and fresh water have especially great significance to the national economy. What is important here is that these resources are relatively close to industrially developed regions experiencing an increasingly greater demand for them.

Among the problems of further development of the West Siberian TPK [Territorial-Production Complex], special importance is attached to increasing extraction of petroleum and gas, which play the leading role in the entire country's fuel and energy balance. Here is what L. I. Brezhnev said in this regard in his speech to the 28th Komsomol Congress: "The Tyumen' reserves will still keep us going for many long years. And in the next decade, we intend to achieve the main increment in the extraction of petroleum and gas and in the production of valuable chemical raw materials from these resources mainly at Tyumen'. In this connection a new, more complex stage of West Siberia's development is beginning or, to put it more accurately, has already begun. The volume of all operations must be doubled and tripled there. This will require both new outlays of materials and equipment and an influx of people into this region."*

Construction of the complex is proceeding, and it is undergoing development. In the harsh natural-climatic conditions, in permafrost, marshes and swamps, a powerful

*Brezhnev, L. I., "Leninskim kursom" [Following Lenin's Course], Moscow, Vol 7, 1979, pp 287-288.

economic potential has been created, one promoting intensive development of the underground treasurehouse of fuel. The increase in extraction of petroleum, including gas condensate, exceeded an average of 100 million tons and gas extraction exceeded 50 billion m^3 every 5 years throughout the entire period of the complex's development. For comparison, let us recall that about the same quantity of petroleum was extracted in the whole country in 1955, and of gas in 1960. During the 10th Five-Year Plan petroleum extraction in Tyumenskaya Oblast increased by a factor of two, while gas extraction increased by a factor of 4.3. This is a world-unprecedented rate of development of oil and gas fields. The West Siberian TPK is already playing the decisive role in formation of the country's fuel balance and in providing petrochemical raw materials to the national economy.

These outstanding successes became possible owing to the far-sighted policy of our party and the harmonious creative labor of many thousands of laborers, engineers, scientists and technicians. The energetic activities of a large number of enterprises supplying the complex with progressive technology and equipment do not play the last role either. This is precisely what made it possible to wage an offensive on the riches of the West Siberian complex from the very beginning not by the strength of numbers but by the strength of knowledge, with the assistance of the most up-to-date equipment and procedures.

New, even more grandiose tasks associated with the complex's further development will be completed in the 11th Five-Year Plan. Extraction of petroleum, including gas condensate, is to be increased by another 80-90 million tons. In this way, the complex is not only compensating for a certain decline in petroleum extraction in other regions, but it will also be responsible for the total increase in extraction in the country. In 1985 the complex is to produce 385-395 million tons of petroleum, including gas condensate--that is, more than 60 percent of the total extracted in the Soviet Union. Each year 1 million tons of liquid fuel will be extracted from its subsoil.

The tasks of gas extraction are even greater. The Medvezh'ye gas field has already been developed. The larger "multistory" Urengoy gas field is now flexing its giant muscles. Waiting in the wings is the northernmost and most difficult deposit--the Yamburg gas field. Exploitation of these larders of the Yamal Peninsula and between the Pur and Taz rivers as well as other deposits in the Tyumen' North will make it possible to extract 330-370 billion m^3 of gas in the end of the 11th Five-Year Plan. And this means that the daily gas yield of the complex will be 1 billion m^3.

Understandably, completion of these large-scale tasks would be possible only on the most up-to-date technical basis. Much has already been done in this regard. A new procedure for extracting petroleum has been created and placed at the basis of a unified system of oilfield remote control. Subterranean energy and deep pumps are being used to transport the petroleum from wells to central handling stations, making it possible to reduce the number of oilfield structures by many times. Special modular equipment, which together with the telemechanical system makes up an integral oil extraction organism, has enjoyed broad application, and it has served as the basis of integrated automation of the oil extraction processes. But even this is no longer enough. The problems of technical progress are acquiring even greater significance in connection with the need for developing new oilfields in even harsher natural and climatic conditions, for progressing to deep and ultradeep wells, for increasing the oil output of the beds, for raising the level of construction's industrialization, for creating more economical forms of transportation and for providing population centers with modern facilities.

The amount oil and gas extraction increases depends significantly on the amount of effort put into drilling and outfitting the wells. The volume of such work will increase significantly during the present five-year plan through introduction of progressive drilling methods, application of new drilling equipment and further industrialization of construction. A highly effective method of cluster slant drilling of wells for oil and gas was used for the first time at the West Siberian complex. This method, which makes it possible to concentrate oilfield facilities in a single area and broadly employ industrial methods of outfitting the oilfields, can ensure a 10-15 percent decrease in built-up territory and a 30 percent decrease in the number of structures and in the length of transportation lines. As a result the number of service personnel decreases significantly.

During the 11th Five-Year Plan, the complex's oil and gas industry will receive more integrated drilling rigs designed for general-purpose installation and for cluster drilling, equipment to mechanize well operation and repair, and automated and modular equipment to outfit the oilfields. The use of new methods to influence the oil reservoirs will be broadened. This will increase extraction of oil from the subsoil. Gas-lift operation of wells and highly productive submersible pumps will be introduced.

A pipeline network of significant length, extending far beyond West Siberia, is an organic unit of the complex's petroleum and gas industry, inasmuch as the bulk of the oil and gas will be transported to other regions of the country, both today and in the future. Pipelines have already been under construction for 15 years. Petroleum is carried from Tyumenskaya Oblast to enterprises of Omsk, Al'met'yevsk and Kuybyshev, and natural gas is carried to Chelyabinsk, Kemerovo, Gryazovets and other cities of the country. A web of thousands of kilometers of oilfield arteries has ensnared the marshy taiga.

Erection of the petroleum and gas pipelines received a new push owing to creation of a high-output specialized construction subdivision, Glavsibtruboprovodstroy, in 1973. While in the first year of this organization's existence it laid about 1,000 km of pipeline, now it is erecting over 4,000 km of pipelines to collect and transport oil and gas and dozens of compressor and oil transfer stations each year. These successes can be explained in many ways by the use of modern equipment and procedures successfully adapted to low temperatures, the lack of roads and the permafrost. Threaded steel oil pipes with new forms of threaded connections and anticorrosion films will be introduced extensively in the 11th Five-Year Plan, and production of multiple-wall pipes for gas lines will expand significantly. This will make it possible to hasten construction of the pipelines, which has priority significance to gas industry. In addition to the four existing gas pipelines, not less than six more--larger and longer ones--must be laid to transport the enormous quantities of Siberian gas to other regions of the country.

One of the most important construction projects of the country's gas extractors today is the Pyatyy Luch gas pipeline, 2,800 km long. It is to connect Urengoy to Moscow. It will pass first through the Tyumen' North and then through the Komi ASSR and Arkhangel'skaya, Vologodskaya, Yaroslavskaya, Vladimirskaya and Moscow oblasts. This pipeline will carry about 100 million m^3 of gas per day.

One of the most serious problems faced by the complex is that of utilizing byproduct petroleum gas. A number of gas refineries have already been built, but their output is still inadequate. A significant part of the byproduct petroleum gas is being burned off for the moment. A ton of Siberian crude contains 60 m^3 of byproduct gas. This means that more than 23 billion m^3 of gas were extracted by the complex's enterprises in 1985. Byproduct gas can be broken down into 70 percent dried gas and 30 percent crude hydrocarbons. Sixteen billion m^3 of dried gas and 7 million tons of crude hydrocarbons were obtained at the end of the 11th Five-Year Plan.

The main consumer of the dried gas is power engineering. The Surgutskaya GRES is now operating with this gas. Capacities making use of dried gas will also be introduced at Surgut's thermal plant during the five-year plan. Owing to this, the task of reinforcing the energy base of petroleum industry and of other national economic sectors in the middle reaches of the Ob' will be completed. Byproduct gas is also used for industrial needs in ferrous metallurgy, chemical and cement industry, and as boiler and furnace fuel in southern regions of West Siberia.

Capacities for integrated processing of byproduct petroleum gas are increasing. Use of this gas is becoming the basis for forming large petrochemical complexes. Productive capacities will be placed into operation at the Tomsk Chemical Plant and the Tobol'sk Petrochemical Combine in the five-year plan. The Tobol'sk plant will specialize in the production of synthetic rubber, and the Tomsk combine will specialize in production of polymerization plastics (polyethylene, polystyrene) and raw materials for synthetic fibers. In the opinion of specialists it would be expedient to create two petroleum refineries to support these enterprises. The savings per ton of light petroleum products resulting from locating petroleum refineries here in comparison with locating them in the European regions of the Soviet Union would be 15-17 rubles in capital investments and 2-3 rubles in operational outlays.

Another important direction in the development of the West Siberian TPK is logging and woodworking industry. More than 21 million m^3 of timber are procured and 3.6 million m^3 of lumber and about 26,000 m^3 of glued plywood are produced here. Moreover, as calculations show, procurement of 1 m^3 of timber here means a savings of 2 rubles, production of 1 m^3 of lumber saves about 7 rubles, production of 1,000 m^2 of wood fiber panels saves 29 rubles, production of 1 m^3 of plywood from deciduous wood saves about 3.5 rubles, production of a ton of wrapping paper saves 6 rubles, production of a ton of writing paper saves over 5 rubles, and production of a ton of cardboard packaging saves about 5 rubles. The product yield per ruble of capital outlays is greater in Tyumenskaya and Tomskaya oblasts than in the forested regions of the Northwest and the Urals. Moreover the forests of these regions are 2,500-3,000 km closer to the European USSR than are the forests of East Siberia. In the future the logging volume in Tomskaya and Tyumenskaya oblasts may grow significantly. Presence of enormous reserves of fuel and water creates favorable possibilities for erecting large enterprises in this area for chemical and mechanical wood processing. It would be suitable to create logging complexes and sawmilling and woodworking combines in the cities of Asino, Surgut and Kolpashevo and in the towns of Kamennyy and Belyy Yar--ones with an output capacity of 4-6 million m^3 of processed wood per year.

Machine building, the main task of which is to manufacture equipment and mechanisms for enterprises and construction projects of the leading economic sectors--is an important element of the West Siberian TPK. Construction of a plant producing chemical and petrochemical equipment is to begin in the 11th Five-Year Plan. In the south of the complex, it would be suitable to develop the repair of large petroleum and gas equipment more intensively.

Analysis of the complex's territorial economic ties revealed a sharp increase in interrayon turnover and local freight traffic. The Tyumen'-Surgut Railroad has taken on a big load. Its erection significantly accelerated development of new deposits of natural fuel. The Surgut-Urengoy Railroad, which will join together the Khanty-Mansi and Yamalo-Nenets national areas, accelerate development of their economies and provide the Tyumen' North access to the south, connecting it to the country's railroad network, is to be placed into operation in the 11th Five-Year Plan. The role of motor and river transport will grow, its material-technical base will be made stronger, and the throughput of river ports will increase. The river fleet will be supplemented by large steamships, vessels capable of mixed "river-sea" navigation, tugs, icebreakers and comfortable passenger ships. Organization of year-round navigation in the western part of the Northern Sea Route will have great significance, owing to which timely delivery of freight to the enterprises and population of the complex will be ensured, especially in those regions of the complex located in the Far North.

Timely preparation of construction sites is an important prerequisite of successful development of deposits. Dirt and millions of tons of sand, obtained from river and lake bottoms by hydraulic methods using hydraulic dredges, are brought in to the construction sites and approach roads are erected 2 or 3 years before the main forces arrive. Usually the sand is delivered from far away over poor roads, meaning that as a rule the outlays on its transportation are tremendous. But sand is available almost everywhere, though sometimes it is encountered at great depth--15-20 meters. It could be extracted by the so-called air lift method, where water and air are injected under pressure into a drilled well to raise slurry to the surface. Were this method of sand extraction to be introduced throughout, we could significantly hasten creation of staging areas and oilfield roads, and reduce the transportation expenses and labor outlays on construction.

Further industrialization of construction has priority significance to the complex. The moduluar method is now a full-fledged citizen of Tyumen' facilities. The bulk of the equipment is manufactured at the plants and delivered to the construction sites in finished form, after which it is installed on a foundation and connected to utility lines. This method reduces construction time a great deal and significantly raises labor productivity and work quality. At present, the staging and support basis providing equipment to the complex's construction projects are located in the southern part of Tyumenskaya Oblast and on the Ural. In the future it would be suitable to create such bases in Kemerovskaya and Novosibirskaya oblasts, using water transportation to handle the cargo; on the return trip, such transportation could be loaded with timber.

Welded foundations and supports are broadly employed in the erection of the complex's facilities. Until recently the motors and machine units of petroleum transfer and compressor stations were mounted on monolithic reinforced concrete foundations. But it is not all that simple to pour concrete in extreme cold. Metal frames are now being used for this purpose. In comparison with the traditional method, the new one reduces consumption of reinforced concrete by a factor of 2.5, labor outlays by a factor of 5 and construction time by a factor of 4. Work quality improves as well.

Serious social problems must also be addressed in the course of development of natural resources on the territory of the complex. The main one is that of selecting the way of populating the North. Which way would be preferable, to create base cities with a permanent population, or to develop the natural resources using the so-called watch and expeditionary methods? After all, it costs the state tens of thousands of rubles to relocate a worker in a new place. It has been estimated that the outlays on maintaining an oil prospecting expedition operating according to the watch method are compensated for by the third or fourth year. In Tyumenskaya Oblast, the watch method has saved hundreds of millions of rubles and made it possible to hasten development of subterranean minerals by several years. Thus in and of itself, the watch method is highly economical. However, if we consider construction of watch towns, which must be furnished with all necessary conveniences, all the more so because the watch workers are subjected to especially harmful conditions, the relative outlays on creation of watch towns would be close to the relative outlays on creating base cities. Thus in resolving the issue as to what method we are to use in developing the territory, we should base ourselves on the concrete conditions, and when necessary we should combine different methods of developing the natural resources on the complex's territory. In the first stages of the territory's development, the watch method would obviously be suitable. In subsequent stages, however, base cities would have to be created. Thus Nadym, the capital of gas extractors of the Medvezh'ye deposit, has become a base city. Had it not been created, development of the Urengoy gas field would have taken many more years, resulting in tremendous losses to the national economy.

The social problems of the complex are not limited to selection of the method for developing the new territory. There are other issues that need to be resolved as well: how to provide manpower to the enterprises, how to stabilize the population, how to create favorable conditions for the work and rest of the people, and others. If we are to resolve them in the 11th Five-Year Plan, we would need to expand construction of residential, municipal, cultural and personal service facilities, strengthen the food base by enlarging agriculture and sectors processing agricultural raw materials, and implement a number of other measures no less important to the economic and social development of the complex.

2. The Kansk-Achinsk Territorial-Production Complex

"Continue formation of the Kansk-Achinsk Territorial-Production Complex."

From the "Basic Directions...."

Formation of the Kansk-Achinsk TPK is associated mainly with development of enormous coal reserves. The name of the complex comes from the Kansk-Achinsk coal basin. This basin is unusual in its dimensions. It stretches over an area of 50,000 square kilometers, bordering on the Trans-Siberian Railroad for 800 km. According to the estimates of geologists, large reserves of coal are concentrated in the Kansk-Achinsk basin. Were we to base ourselves on the present level of coal extraction in our country, these reserves should last us many years. The most promising coal-bearing regions in the basin are the Itat-Bogotol'skiy, Nazarovskiy, Balakhtinskiy, Priyeniseyskiy, Rybinskiy and Sayano-Partizanskiy. The principal coal beds, development of which is possible by the most effective open-cut method, are concentrated on their territory.

Of course, not all of the deposits are ready for practical development today. Many of them still have to be studied, measured and weighed, so that the future open coal pits could be built on a sound and dependable raw material foundation. However, even the coal reserves we have today that are prepared for industrial development can support development of coal industry on an unprecedented scale.

The mining and geological conditions of developing the Kansk-Achinsk coal deposits are exceptionally favorable. The main coal bed, which consists of a seam from 5 to 90 meters thick, lies horizontally as a rule, making it possible to develop it with high-power equipment. Also important in this case is the fact that the coefficient of stripping operations at deposits that may be developed by the open-cut method is not very great. It varies from 1 to 3 m^3 of earth per ton of coal. This is several times less than in other coal basins of the country.

In the future creation of dozens of high-output quarries with a total annual coal yield of 1 billion tons will be possible on the territory of the Kansk-Achinsk TPK. This would be 1.6 times more than the present coal yield of the country as a whole. Development of the complex's coal resources has already begun. Two open pits are already operating at the Nazarovskoye and Irsha-Borodinskoye deposits, which are producing tens of millions of tons of coal. The Berezovskiy open coal pit, which will go into operation in the 11th Five-Year Plan, is presently under construction.

The Kansk-Achinsk basin is attracting attention not only in view of the size of its coal reserves but also due to the high technical-economic indicators of coal extraction. Take for example an indicator such as unit capital investments. They are several times less here than in other basins of the country. Given the same volume of capital investments, eight times larger coal extraction capacities can be created in the Kansk-Achinsk basin than in the Donets Basin. The cost of Kansk-Achinsk coal is much below the cost of coal from other basins. An increase in its extraction to 80 million tons would reduce the average cost of coal mined in the USSR by 10 percent, and of all fuel by 6 percent. The corrected outlays per ton of Kansk-Achinsk coal are lower than those on extracting an equivalent quantity of Tyumen' or Orenburg gas. And finally, the Kansk-Achinsk basin has no equals in terms of an important indicator such as labor productivity. Up to 2,000 tons of coal can be mined here per worker per month. This is 10 times more than the average labor productivity indicator of the country's coal industry.

The most important factor, one which primarily defines the high economic effectiveness of coal mining in the Kansk-Achinsk basin, is the favorable conditions in which the coal is situated, making it possible to create high-output open pits. The output capacity averages 30 million tons, while in the Ekibastuz basin it is 17, in the Kuznetsk basin it is 5 and in the Podmoskovskiy basin it is 1 million tons. The output of some open pits in the complex may be increased to 45 and even 60 million tons. The high capacity of the open pits makes it possible to use progressive systems for developing the coal deposits, using the latest ultrapowerful highly productive equipment.

The Ural Machine Building Plant manufactured the world's most powerful walking dragline for stripping operations at the Nazarovskiy open coal pit. Its bucket, which has a capacity of 100 m^3, can carry a tremendous load for great distances with the help of a 100-meter boom. A rotary excavator with a productivity of 5,000 m^3 per hour is operating at the Irsha-Borodinskiy open pit, and a heavy excavator plant that will support development of coal pits of the Kansk-Achinsk basin is under construction in Krasnoyarsk. The first generation of this plant, which may be referred to as the Siberian version of the Ural Machine Building Plant, will go into operation in the current five-year plan. This will make it possible to dispense with the extremely significant transportation outlays. After all, the outlays for delivering high-power excavators to this place from the European regions of the country reach as much as 50 rubles per ton of their weight. Use of conveyor transport, which increases the productivity of mining equipment, simplifies delivery of the fuel to the hoppers of thermal power plants and makes it possible to move stripped rock to storage dumps with minimum damage to agricultural land, is expanding.

Resolving the issue of how to use Kansk-Achinsk coal in the national economy, we should consider its quality. The problem is that Kansk-Achinsk coal contains a significant quantity of moisture--up to 40 percent. When this moisture evaporates, the coal breaks apart to form dust, which oxidizes quickly and acquires the capability of spontaneous combustion. The coal freezes in winter. All of this makes it unsuited to long-term storage and to transportation over great distances. Nor can we forget that Kansk-Achinsk coal has a low calorific value--from 2,500 to 4,000 calories per kilogram. This makes it less competitive than coal from other basins of the country. Thus outlays on extracting and transporting Kansk-Achinsk coal to the Urals are 20-25 percent higher, per ton of comparison fuel, and unit capital investments are 6 percent higher than for Donetsk coal. Therefore the main direction in the use of this coal is to build large thermal electric power plants at the places of the coal's extraction. This effort has begun. One of the country's largest thermal electric power plants--the Nazarovskaya GRES--is already producing current. Output capacities of the Berezovskaya GRES, presently under construction next to the Berezovskiy Coal Pit No 1 in the vicinity of the town of Sharypovo, will be placed into operation in the current five-year plan.

The country's largest power production block at the Kostromskaya GRES recently began producing current for industrial needs. Having an output capacity of 1.2 million kw, its start-up marked a new stage in the development of domestic thermal power engineering. A new generation of high-power electric machines, ones which may enjoy broad application at thermal power plants of the Kansk-Achinsk complex, is being created on its basis.

The effectiveness of developing electric power engineering on the basis of Kansk-Achinsk coal is extremely great. Thus in terms of the cost of electric power, the complex's large thermal power plants can compete with hydroelectric power plants of the Volga-Kama cascade, which is one of the most effective in Europe. This is all the more indicative if we consider that unit capital outlays per kilowatt of attained output at thermal electric power plants are significantly lower than at hydroelectric power plants. When electric power is transmitted over great distances, the outlays at the points of consumption rise significantly. But in this case they would not be any higher than those for power from electric power plants in the European part of the country. The difference lies in the technical concept with which this problem is resolved, the essence of which boils down to introducing ultralong and ultrapowerful transmission lines.

But it would be most effective of all to use the complex's electric power locally to create high-energy production operations. In this case the fuel savings would exceed the additional outlays on delivering the products to consumers and on importation of raw materials from other regions. Thus were we to smelt a ton of aluminum using electric power obtained with Kansk-Achinsk and Donetsk coal and compare the outlays, we would find that they would be less in the former case than in the latter. Moreover high-energy industrial sectors require significantly less manpower than do low-energy sectors. This is especially important to the complex, since it is experiencing a manpower shortage.

Kansk-Achinsk coal can be used as fuel for power production in other regions of the country as well. There is special interest in the possibility for replacing more expensive Kuznetsk coal in West Siberia by Kansk-Achinsk coal. But this would require enrichment of the coal: Its calorific value would have to be raised, and it would have to be made more transportable, which would require additional outlays. These outlays should not exceed 4-5 rubles per ton of comparison fuel. Only in this case would this coal compete with Kuznetsk coal mined by the open-cut method in the market of the country's central region.

Development of coal industry, thermal power engineering and high-energy production operations generates a number of serious problems in environmental protection. They include land recultivation, protection of the landscape and utilization of stripped rock, ash and clinker. Alumina wastes are being used in Achinsk to produce cement that is much cheaper than the average for the country.

The Achinsk, Kansk and Nazarovo industrial centers are taking shape on the complex's territory. The production profile of the Achinsk industrial center is represented by energy-rich production operations such as alumina, petroleum refining and cement, which will enjoy further development in the current five-year plan. Relying on intensive agriculture, food industry is developing continuously. In the future this industrial center will be supplemented by machine building enterprises. The Kansk industrial center is one of the most important centers of development of the Kansk-Achinsk brown coal basin. It has the potential for developing chemistry on the basis of enormous reserves of high-quality salt from the Kansko-Tessevskaya salt depression. The Nazarovo industrial center is specialized in coal mining and in the production of thermal electric power. A large material-technical base has been created here for construction.

Thus the production profile of the Kansk-Achinsk Territorial-Production Complex is represented by coal industry, thermal power engineering, some sectors of nonferrous metallurgy and cement production. The closeness of the complex to West Siberian petroleum and its good transportation ties are promoting development of petroleum refining and petrochemistry. It would be advantageous to locate enterprises manufacturing machines and equipment for fuel, power and mining sectors on its territory, since this would produce a savings in transportation costs. Agriculture, construction industry and construction of residential, cultural and personal service facilities have important significance, since they play an important role in creating conditions which would attract people and keep the population stable.

In the future the Kansk-Achinsk Territorial Production Complex will become one of the most important fuel and energy bases, ensuring the dependability of our country's fuel and energy balance.

3. The Sayansk Territorial-Production Complex

"Ensure further development of the Sayansk Territorial-Production Complex."

From the "Basic Directions...."

While living in exile in the village of Shushenskiy on the Yenisey River, V. I. Lenin delighted in the rare beauty of the mountains of Sayansk and dreamed of a time when the liberated people would be able to begin true development of this unique land and place its highly rich resources in the service of a free Russia. There are not very many regions in our country enjoying such a combination of natural and economic factors favoring creation of a territorial-production complex as does the southern part of Krasnoyarskiy Kray. Sizeable water, energy and timber resources and deposits of iron ore, nonferrous metals, coal, asbestos, phosphorites and marble are concentrated here in a relatively small territory, and there are convenient areas for industrial and residential construction. The network of railroads and highways ties the complex to the industrially most developed regions of Siberia. The relatively mild, "almost non-Siberian" climate, which permits successful development of agriculture and facilitates attraction and stabilization of a population, favors development of a multiprofile production complex.

In the future the Sayansk TPK will become one of the largest not only in Siberia but also in the entire country. It will contain more than 100 large industrial enterprises outfitted with the latest equipment. More than a million persons will reside on its territory.

Production of cheap electric power and electrometallurgy (nonferrous metal smelting) and machine building organized on its basis will become the leading national economic sectors of the Sayansk Territorial-Production Complex, ones predetermining its all-union specialization.

The heart of the complex is the Sayano-Shushenskaya GES, which will produce about 24 billion kw·hr of electric power annually. Moreover the cost of this electric power will be several times lower than the union average. The Yenisey was successfully dammed in October 1975 for construction of the Sayano-Shushenskaya GES, and as early as in January 1976 the first cubic meters of concrete were poured into the part of the dam to serve as the power plant's foundation. The turbines for the plant's machine units are being manufactured by the Leningrad Metals Plant imeni XXII s"yezd KPSS. The first machine unit of the Sayano-Shushenskaya GES went into operation in late 1978. By this time about 4 million cubic meters of concrete had been poured for the dam and the plant building. This rate of concrete pouring was unprecedented in world practice. In order that the concrete conveyor could work at full steam, fundamentally new production processes were introduced into construction, the most sophisticated machines and mechanisms were installed, and the productivity of concrete plants was raised.

The Sayano-Shushenskaya GES has no equals in world hydraulic engineering construction in terms of many of its technical-economic indicators and engineering concepts. The height of the dam is almost 250 meters. Its erection required about 10 million m^3 of concrete--almost twice more than the Krasnoyarskaya GES. Ten machine units each producing 640,000 kw will be installed at the Sayano-Shushenskaya GES. Hydraulic machine units of such power do not yet exist either in our country or abroad. Nor has such a high coefficient of useful turbine action ever been reached in world practice: It exceeds 95 percent.

Builders' villages are growing hand in hand with the Sayano-Shushenskaya GES. In 1975 all of the left-bank villages--Oznachennoye, Mayna and Cheremushki--were combined into a city that came to be called Sayanogorsk. This is one of the youngest cities of the USSR.

Planners also developed a highly effective innovation associated with operation of the first machine units of the hydroelectric power plant. While the former practice in construction of hydroelectric power plants was to get the first machine units to begin producing electric power as erection of the dam neared completion, the Sayano-Shushenskaya GES was able to produce current before the concrete operations were less than half finished. This innovation, according to the most conservative estimates, will make it possible to obtain an additional 16 billion kw•hr of electric power--that is, as much as had been produced by all of the country's hydroelectric power plants just a quarter of a century ago.

Construction of the Sayano-Shushenskaya GES will basically be finished in the 11th Five-Year Plan. The bulk of its electric power will support industry, transportation and the municipal and domestic needs of the complex itself. High-voltage electric power transmission mainlines will make it possible to deliver surplus power to other consumers of the Siberian power system, especially in high-water years.

The main consumer of electric power in the complex will be the Sayansk Aluminum Plant, some of the productive capacities of which will be placed into operation in the current five-year plan. This enterprise is being built 20 km from Sayanogorsk. This airplane metal plant will enjoy the sector's highest level of production and control automation. Also under construction are the Tuim Nonferrous Metal Processing Plant and the Sorsk Molybdenum Combine.

A rail car building plant being erected near Abakan will be the largest machine building enterprise of the Sayansk complex. When it reaches its planned output capacity, it will become the country's largest rail car building enterprise. Each year this plant will provide 40,000 high-capacity rail cars to the national economy. The Abakan Rail Car Building Plant will be outfitted with modern highly productive equipment, and it will make use of the latest technology. The eight-axle all-metal 120-125 ton boxcars it manufactures will gradually replace the lower capacity four-axle rail cars presently in use. They will make it possible to raise the loading capacity of trains to 10,000 tons without significantly increasing their length, and to increase the carrying capacity of the railroads.

In order to supply the plant with the material it needs, a large steel casting operation has been organized and outfitted with highly economical high-capacity electric furnaces. Each year the plant will produce 320,000 tons of forgings, which will not only be used by the plant itself but also be supplied to other enterprises. Rolled aluminum, which can help to reduce the weight and improve the structure of rail cars and enhance their appearance, will enjoy broad application in rail car production.

Another highly important form of production of the Abakan Rail Car Building Plant is railroad containers. Forty thousand of them will be produced each year. Some of the output capacities of this plant have already been placed into operation. More time will be required, however, before this giant enterprise reaches its planned output capacity. There are plans for building 600,000 m^2 of housing space--that is, practically an entire city.

Construction of electrical engineering enterprises of varying profile and size will be continued in the Sayansk complex. The most important of them are to be located in the vicinity of Minusinsk. They will produce turbogenerators and hydraulic generators, ones with output capacities in the millions, power transformers, apparatus for high-voltage power lines, various cable and insulating materials which are now being imported from the European part of the country. These enterprises will also produce consumer goods, particularly appliances for electric kitchens. The electrical engineering plants in Minusinsk released their first products as early as in the 10th Five-Year Plan. The number of workers at the electrical engineering enterprises will be 60,000-70,000 persons when they achieve their full rated capacity. Owing to compact location of the electrical engineering enterprises, much money will be saved. It has been estimated that had these enterprises been located in different places, the outlays on their construction would have been over 100 million rubles more, and their operation would have required an additional 10,000-15,000 workers.

A large quantity of construction materials enterprises and construction industry enterprises are being built on the territory of the Sayansk complex. Thus for example the housing construction combine of the Abakan Rail Car Building Complex is intended for an annual output of 170,000 m^2 of housing space, while the prefabricated housing plant of the Sayanskaya GES will have an output of 35,000 m^2, and so on. Most of these enterprises will be supported entirely by local high-quality raw materials. The stoneworking combine created at the large Kibik-Kordonskaya deposit of high-quality marble has nationwide significance. Its first generation, which is already operating, is intended for an annual output of 250,000 m^2 of marble facing panels. Polished panels made of colorful Sayansk marble containing more than 20 different shades--white, pink, red, green, black etc.--have enhanced the appearance of subway stations, theaters, palaces of culture and other buildings in many cities of the country. Lazurite, a precious gem found in Sayansk and having a blue color rarely found in nature, is extremely valuable and rare.

However, were enterprises of just the leading sectors to be included in the composition of the Sayansk complex, as it took form we would have had to deal with the problem of providing work for women. After all, the rail car building plant at the metallurgical enterprises would be employing men for the most part. Development of light and food industry helps to solve this highly important problem. Thus a wool primary processing factory has been built in Chernogorsk. The well conceived structure of the Minusinsk industrial center is advantageously supplemented by a knitted glove factory. A wood pulp production operation developing in Krasknoyarskiy Kray is serving as a base for construction of a synthetic leather combine in the Sayansk complex.

Serious attention is being devoted in the complex's formation to construction of new railroads and highways and reconstruction of existing ones, both internal (linking the industrial centers of the complex) and external, leading to neighboring industrially developed regions.

Creation of the Sayansk complex made it necessary to improve the evolved specialization of agriculture in the southern part of Krasnoyarskiy Kray. In order to satisfy the demands of the fast-growing population, many of the kolkhozes and sovkhozes specialized in grain farming have supplemented their production with crops intended to support an urban population, with vegetables being in high proportion among them.

Dozens of scientific research institutes and other organizations have been working several years on problems associated with formation of the Sayansk TPK, on the grounds of its optimum production structure and on the planning of industrial enterprises within its composition. Much attention is devoted in this case to preserving the natural environment on the complex's territory and preventing pollution of water sources and the air.

Of course, it will take more than one five-year plan to complete formation of the Sayansk TPK, but certain of its enterprises and production operations are already producing, and others will go into operation in the next few years. The complex is gaining strength, its construction base and construction of housing, municipal, cultural and personal service facilities are developing, its economic development is becoming more integrated, the personnel availability is rising and the complex's importance to the country's economy is growing.

IV. Territorial Production Complexes of Central Asia and Kazakhstan

TPKs have already occupied a firm place in the territorial organization of the economies of the republics of Central Asia and Kazakhstan. The Karatau-Dzhambul and Mangyshlak complexes have taken shape, and they are continuing to develop. The South Tajik complex is enjoying further growth in the 11th Five-Year Plan, and the Pavlodar-Ekibastuz TPK is developing as well.

1. The South Tajik Territorial-Production Complex

> "Continue erection of the Yavan Electrochemical Plant and introduce new output capacities at the aluminum plant of the South Tajik Territorial-Production Complex."
>
> From the "Basic Directions...."

The natural resources and the high concentration of inhabitants and manpower characteristic of the South Tajik TPK are advantageous factors determining the structure and scale of its formation and development. Among the natural resources, hydroelectric power has priority significance in this area. It represents 7.5 percent of all hydroelectric power resources of the country and about half of the hydroelectric power resources of Central Asia.

The rivers of southern Tajikistan--the Vakhsh, Pyandzh and Kafirnigan--offer potential hydroelectric power resources exceeding 160 billion kw•hr, of which almost half can be used today with a great economic impact. In terms of relative channel power (1 kw per 1 km), the Vakhsh River, which is the right tributary of the Amu-Dar'ya, surpasses not only the major rivers of Central Asia but also such giants as the Volga, Yenisey and Angara. According to some estimates eight hydroelectric power plants can be built along it, with a total channel power of about 9 million kw and a yield of 36 billion kw•hr of electric power. The hydraulic power resources of the Pyandzh River are even more significant. In the relatively near future a cascade of 13 electric power plants with the total power twice exceeding that of the cascade of hydroelectric power plants on the Vakhsh will be erected.

There are significant reserves of mineral resources on the territory of the South Tajik complex: deposits of nonferrous metal ores, petroleum, gas, coal, limestone, fluorspar, dolomite and nephelinic (spenit). A significant proportion of the country's reserves of table salt are concentrated here.

Southern Tajikistan enjoys extremely favorable natural conditions for the development of agriculture. A combination of intense sunlight, large reserves of water and presence of sizeable amounts of flat land creates especially favorable conditions for growing the best varieties of cotton, a number of subtropical crops and the country's earliest vegetables on open ground.

The fact that the Tajik SSR will have a better supply of manpower than many other regions of the country in the near future will also play an important role in the development of the South Tajik TPK.

Construction of the Nurekskaya Hydroelectric Power Plant, one of the largest in Central Asia, represented the start of the first stage of intensive formation of the South Tajik Territorial-Production Complex and development of its natural resources. The first three machine units of the Nurekskaya GES, with a stable power of 900,000 kw, went into operation in 1972. In the 10th Five-Year Plan the power of the Nurekskaya GES attained 2.7 million kw. Construction of the Rogunskaya GES with a power of 3.6 million kw is to occur on the Vakhsh River and the Baypazinskaya GES with a power of 340,000 kw is to be placed into operation during the current five-year plan. Later on, the Dashtidzhumskaya Hydroelectric Power Plant with a power of 4 million kw is to be built on the Pyandzh River.

The Rogunskiy hydraulic engineering complex, which includes the hydroelectric power plant and a large reservoir (with a total volume of 8.6 cubic kilometers), will be significant in ways other than as a major power source. It will play a great role in regulating the discharge of the Amu-Dar'ya and in development of irrigation. The Baypazinskiy hydraulic engineering complex will be important mainly for irrigation: It will provide water to the Yavanskaya Plain, and it will regulate the daily discharge of the Nurekskaya GES.

Hydraulic power engineering at the South Tajik complex is distinguished by high economic effectiveness. As an example the corrected outlays per kw-hr of electric power produced by the Nurekskaya GES are only slightly disadvantageous in comparison with the indicators of the largest Siberian hydroelectric power plants. However, in view of the exceptional ruggedness of the republic's mountain terrain, construction of power transmission lines is very expensive, making transmission of electric power to other regions unfeasible. This is why using the cheap electric power locally is the most effective. This significantly predetermines the structure and rate of growth of the industrial complex, which is oriented primarily on development of energy-intensive production operations.

The main consumer of the complex's electric power today is the aluminum plant in Tursunzade, which processes imported alumina and provides high-quality aluminum to the country. A new procedure of obtaining aluminum using locally produced calcined annodes was introduced here for the first time in Soviet practice. As a result of this procedure not only is the plant producing especially pure metal, but it is also significantly reducing harmful discharges into the atmosphere. Mention should be made of the high economic effectiveness of the production of South Tajik aluminum, the per-ton production cost of which is close to the production cost of Siberian aluminum plants. When new output capacities are introduced at this enterprise in the current five-year plan, the plant will transform into one of the largest in the country.

Chemical industry is a consumer of the complex's chief electric power. The Vakhshsk Nitrogen Fertilizer Plant, which uses Central Asian gas as its raw material, has been producing for several years. The plant provides for a significant proportion of the nitrogen fertilizer demand of the Tajik SSR, and it exports fertilizers to neighboring republics. In the future the plant's mineral fertilizer output capacity will be expanded, inasmuch as the demand of Tajikistan for nitrogen fertilizers will grow in connection with the planned development of irrigated agriculture. Simultaneously the plant will produce methanol, toxic chemicals, carbamide, formaldehyde, ammonium nitrate and other products.

Construction of the Yavan Electrochemical Plant is continuing in the 11th Five-Year Plan. It will be producing high-energy products such as chlorine, chlorine products and caustic soda, and later on it will produce soda ash, metallic magnesium and other products. There are plans for creating, at the Yavan plant, operations producing polyvinyl chloride, film and tubing made from the former, fiber glass and other products satisfying the demands of a number of the sectors of the national economy and the population's personal needs. In 1978 the first line producing neutral calcium hypochloride was placed into operation. Table salt from the Tut-Bulakskoye deposit, lime from the Puskhurskoye deposit, fluorspar from the Takobskoye deposit and natural gas brought in by pipeline serve as the raw materials for its production.

Another electrochemical plant operating on the basis of table salt, enterprises producing chemical fibers and other chemical enterprises will be built in the more remote future.

Machine building is also developing in the South Tajik TPK. Its products will not only satisfy the republic's demand but will also be exported to other regions of the country. The complex is now producing complex products such as refrigerators and equipment for public food services enterprises and textile industry. The Kurgan-Tyubinskiy transformer and cable plants are in operation, and spare parts are being produced for agricultural machinery. The complex's machine building enterprises are undergoing reconstruction and expansion. In the future new, predominantly labor-intensive machine building production operations will be created on the basis of the rich iron deposits. Considering the nationality characteristics of Tajik's manpower, particularly the low mobility of the population, small enterprises or branches, divisions and shops of machine building plants need to be built in rural regions.

Sectors of the agroindustrial complex are developing intensively in the South Tajik TPK. Cotton growing and processing occupy a leading place, especially in relation to fine-fiber varieties. The complex produces 75 percent of all Tajikistan's cotton, more than 8 percent of all of the country's raw cotton and about a third of its fine-fiber varieties. Today the cotton yield in southern Tajikistan attains 40-50 centners per hectare. Highly productive varieties of cotton which may produce up to 60 and more centners of cotton per hectare have been introduced. A ton of fine-fiber Tajik cotton can produce 15,000-20,000 meters of fabric, while 10,000-12,000 meters can be obtained from a ton of medium-fiber cotton. Cotton seeds are used to produce oil and oil cake.

One extremely important problem of unionwide significance is creation of a major early vegetable, fruit and grape growing base at the complex in order to satisfy the demand for these products of not only the local population but also the populations of Siberia and the Far East. At present southern Tajikistan produces only 1 percent of the country's fruits and vegetables. This is much less than its potential. The natural and climatic conditions of the complex's territory permit the harvesting of early varieties of white cabbage in the first half of April, cucumbers in the beginning of May and tomatoes in mid-May. Some varieties of vegetables may be grown practically year-round in a number of regions of the complex.

The natural and climatic conditions and the land resources of southern Tajikistan will make it possible to increase the area of orchards in the complex by 2.5 times and of vineyards by 5-7 times. There are sizeable land areas which can be irrigated and used for orchards and vineyards. Moreover 350,000-400,000 hectares of rich land that are presently occupied by cereal crops and summer pastures, or are not used at all, may be used for orchards and vineyards. The valley of the Vakhsh provides all of the conditions for significantly increasing citrus fruit production.

Industrial sectors such as oil milling and tallow, winemaking, leather footwear, meat and dairy, fruit canning and others are closely associated with agriculture. As agriculture develops, as its structure changes and as nationwide specialization in the production of cotton, vegetables and fruits intensifies, food industry sectors oriented on production of foods for local consumption and for export to other regions of the country will develop.

The South Tajik complex also faces serious social tasks. One of them is to develop cities, to create a large number of new jobs within them, mainly in labor-intensive industrial sectors, and to encourage young people to move to the cities. In this connection the question of preparing skilled workers acquires special significance.

The development of productive forces planned for the South Tajik TPK will significantly raise the effectiveness of its production and its role in all-union territorial division of labor.

2. The Pavlodar-Ekibastuz Territorial-Production Complex

"Increase coal mining and alumina production, continue construction of major hydroelectric powerplants with a capacity of 4 million kilowatts each, place the second generation of the petroleum refinery of the Pavlodar-Ekibastuz Territorial-Production Complex into operation. Basically finish reconstruction of the Pavlodar Tractor Plant."

From the "Basic Directions...."

The sizeable fuel, energy, mineral and raw material resources of the Pavlodar-Ekibastuz TPK are the principal foundation for its formation and further development. It possesses large deposits of coal and lignite, of copper and polymetallic ores, of table salt and of various construction materials. The Ekibastuz and Maykubenskiy coal basins, which are among the most promising of the USSR in terms of the economic effectiveness of their utilization, have the greatest significance to the complex's development.

The Ekibastuz deposit is distinguished by the density of the coal accumulations and the thickness of the coal seams. The balance reserves of industrial-grade coal are over 7 billion tons. The deposit produces high-energy and high-calorie coal, but it is distinguished by a high ash content. The mining and geological conditions permit open-cut mining to a depth of 600 meters. The cost of extracting Ekibastuz coal is the lowest in the country today, being a little more than 1 ruble per ton, and in the future it will drop to 45-50 kopecks.

In the Maykubenskiy basin, the industrial reserves of which are estimated at 17 billion tons, the thickness of the coal seams attains 1,000 meters. Maykubenskiy coal is a fabulous high-energy fuel. A number of deposits of this basin have been thoroughly explored and prepared for operation. According to data of the "Tsentrgiproshakht" [not further identified] institute the cost of a ton of comparion fuel is 1.36 rubles, and relative capital investments are 4.43 rubles.

The Boshchekul'skoye copper deposit, one of the country's largest, has important significance. In addition to copper, the ore from this deposit contains industrial concentrations of molybdenum, cobalt and alumina. The Kozhanskoye, Zhambuldiyskoye, Zhusalinskoye and Priekibastuzskoye deposits occupy a noticeable place in the ore balance. Mention should be made of the Maykanskoye, Tortkudkskoye and a number of other polymetallic ore deposits and of the nickel ore deposit in Bayan-Aul'skiy Rayon, Pavlodarskaya Oblast.

Table salt deposits are highly significant to development of chemical industry, while deposits of fused limestone are important to ferrous metallurgy.

The natural and climatic conditions permit effective agricultural production in this area.

The location of the Pavlodar-Ekibastuz TPK is favorable in terms of transportation and geography. A significant economic potential has already been created here, and many of the socioeconomic problems have been solved.

The 10th Five-Year Plan was a giant leap forward in the complex's development. Speaking at the 26th CPSU Congress, D. A. Kunayev, a member of the CPSU Central Committee Politburo and 1st Secretary of the Kazakh SSR Communist Party Central Committee, noted that the Pavlodar-Ekibastuz complex "is already providing the country with tractors, ferroalloys, alumina and chemical and petroleum refining products. The complex is becoming the largest fuel and power region, providing more than 70 million tons of coal per year.... Three power production blocks of the first Ekibastuzskaya GRES, the output of which significantly exceeds that of the Dneproges, are already producing current. And a total of 37 more power production blocks of this sort are still to be placed into operation. A world-unprecedented superlong energy bridge feeding direct current from Ekibastuz to the country's center is now under construction."*

Development of the complex's industry is characterized by continually growing production indicators, high economic effectiveness and broad introduction of the achievements of domestic science and technology.

Today the complex dispatches 40-50 heavy trains of coal every day. Ekibastuz fuel is used by 20 electric power plants of the Kazakh SSR, the Urals and Siberia for a total output of 15 million kw--more electric power than the total produced in the country in the prewar years. While at the beginning of the 10th Five-Year Plan, in 1976, Ekibastuz provided 46.1 million tons to the country, at the end of the five-year plan it provided over 70 million tons. This rate of increase of output in mining industry had never been witnessed before in Soviet and world practice. The output of the world's largest open coal pit, the "Bogatyr'," is 50 million tons of coal per year. Following reconstruction, its output will increase to 90 million tons per year. Moreover calculations confirm the effectiveness of building an open pit with an output of 20 million tons of coal per year at the Maykubenskoye deposit.

All of this will create a firm foundation for development of power engineering on the territory of the complex. In the next 15 years, four large hydroelectric power plants will be built here in the vicinity of Ekibastuz, and another one will be built near Lake Balkhash, for a total output of 20 million kw--three times more than the capacity of the world's largest Krasnoyarskaya GES. The first power production block of the Ekibastuzskaya GRES No 1 began handling an industrial load in April 1980. By the time the 26th CPSU Congress was convened--that is, in less than a year, three power production blocks were already producing current. Preparations have been started for construction of the GRES No 2. Efforts are being made simultaneously to solve the complex engineering and technical problems of maintaining a continuous supply of fuel for the large GRESs now under construction. For example after it reaches its peak operating capacity, the GRES No 1 will consume 2,000 tons of fuel per hour, and it will require 100 m^3 of water every second.

"XXVI s"yezd KPSS. Stenograficheskiy otchet" [The 26th CPSU Congress. Stenographic Transcript], Moscow, Vol 1, 1981, p 124.

Development of power engineering and coal industry on such a scale would have been impossible, had the problem of supplying water not been solved beforehand--had not the high-capacity 500 kilometer Irtysh-Karaganda canal, which is now being lengthened to Dzhezkazgan, been built.

The complex's power production facilities will transmit 42 billion kw·hr of electric power to the country's central regions along the Ekibastuz-Tambov power transmission line, presently under construction. A significant quantity of the complex's electric power will be used in the Urals and in eastern, central and southern Kazakhstan. However, it would be most advantageous to use this electric power locally, in the Pavlodar-Ekibastuz TPK, for development of energy-intensive production operations. One such enterprise is the Yermakovskiy Ferroalloy Plant, specialized in the production of ferrosilicon, ferromanganese , silicomanganese, refined ferrochrome and other ferroalloys. Its output capacities were increased, production of progressive forms of ferroalloys needed by the country was expanded, and new production operations were organized during the 10th Five-Year Plan, permitting integrated use of poor manganese and chromite ore and high-ash Ekibastuz coal.

Aluminum industry is continuing to develop intensively at the territorial-production complex. The principal product of the Pavlodar Aluminum Plant--alumina--bears the State Seal of Quality. In the opinion of specialists favorable conditions for organizing aluminum production will be created at the TPK in the more-remote future. Cheap electric power and presence of water resources and local raw materials will make this possible. Use of the tailings from Ekibastuz coal enrichment as a source of alumina may provide a new impetus to development of aluminum industry.

Chemical industry is developing in the complex. The first generation of an oil refinery has been erected and placed into operation. The Basic Directions of the USSR's Economic and Social Development in 1981-1985 and in the Period to 1990 foresee introduction of the second generation of the oil refinery in the 11th Five-Year Plan. This will produce favorable conditions for developing petrochemistry, polymer and plastic chemistry and production of protein-vitamin concentrates so urgently needed by Kazakhstan's animal husbandry.

The growing demand of Kazakhstan's agriculture for mineral fertilizers and the presence of a large quantity of cheap electric power and raw materials make it suitable to create nitrogen and phosphorus fertilizer production operations in the territorial-production complex.

Machine building will enjoy significant development in the complex. The flagship of this sector is the Pavlodar Tractor Plant, which is now producing tracked vehicles. Decisions of the 26th CPSU Congress foresee completion of this enterprise's reconstruction in the 11th Five-Year Plan.

Broad possibilities for raising the effectiveness of the leading industrial sectors are associated with increasing the fullness with which raw materials and production wastes are utilized. Thus for example, slag from Ekibastuz coal production may be used to obtain construction materials, particularly lime-slag and sulfate-slag cement. Wastes from alumina production--slurry--can also be used in cement production. Vanadium and other useful components can be extracted from alumina slurry.

Creation of a sound food base, further development of agricultural production and expansion of the suburban agricultural base are important problems of the Pavlodar-Ekibastuz Territorial-Production Complex. The problems of supplying water to agriculture and developing irrigated farming are acquiring important significance in this connection. The bulk of the irrigated land will be located within the zone of the Irtysh-Karaganda canal and in areas that can be irrigated by the Irtysh River. There are plans for increasing the area of river valley irrigation. A large animal husbandry complex is to be built and placed into operation in the 11th Five-Year Plan in the vicinity of the city of Ekibastuz. It should play a major role in providing foodstuffs for the population. It will fatten 54,000 pigs a year, and its poultry factory will grow 3 million broilers each year.

Much is being done in the territorial-production complex to develop the social infrastructure. Housing construction is to expand significantly, a nursery providing plants for the cities is to be placed into operation, and an enterprise repairing complex household appliances and many other facilities helping to improve the population's living conditions will begin operating in the 11th Five-Year Plan.

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